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Original Research Article

Retrospective Comparison of Surgical Outcomes in Posterior Polar Cataracts: Phacoemulsification versus Manual Small Incision Cataract Surgery

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Abstract:

Background: Posterior polar cataract (PPC) is a rare congenital lens opacity associated with a fragile posterior capsule, posing a high risk of intraoperative complications such as posterior capsular rupture and vitreous loss. Optimal surgical management is crucial to achieve favorable visual outcomes while minimizing complications.

Aim: To compare the surgical outcomes, visual recovery, and complication rates of phacoemulsification and manual small incision cataract surgery (MSICS) in patients with posterior polar cataract.

Methods: One hundred PPC patients who had cataract surgery at the Department of Ophthalmology, Hitech Medical College and Hospital, Rourkela, were included in this retrospective observational study. Participants were split evenly between two groups: MSICS (n = 50) and phacoemulsification (n = 50). Demographic information, intraoperative complications, postoperative visual acuity after one week, one month, and three months, preoperative visual acuity, and postoperative complications were gathered. SPSS version 23.0 was used to conduct the statistical analysis. Frequencies and percentages were used to represent categorical data, whereas mean ± SD was used for continuous variables. Chi-square and independent t-tests were used, and a p-value of less than 0.05 was deemed significant.

Results: Both surgical methods worked well and were safe. Although they were not statistically significant, intraoperative problems like as posterior capsular rupture and vitreous loss were somewhat more common in the MSICS group. The mean best-corrected visual acuity (BCVA) at 3 months for phacoemulsification patients was 0.12 ± 0.05 LogMAR, which was a faster visual recovery than the MSICS group's 0.22 ± 0.07 LogMAR ($p < 0.001$). There were no endophthalmitis instances, and postoperative consequences were minimal and similar between groups.

Conclusion: Phacoemulsification provides faster visual rehabilitation and a slightly lower risk of intraoperative complications, making it the preferred surgical approach for PPC when resources and expertise are available. MSICS remains a safe and effective alternative in resource-limited settings.

Recommendations: Careful preoperative evaluation and meticulous surgical technique are essential in PPC. Phacoemulsification is recommended for patients where early visual recovery is desired, whereas MSICS may be considered in centers lacking phacoemulsification facilities. Further prospective studies with larger cohorts are suggested to validate these findings.

Keywords: Posterior Polar Cataract, Phacoemulsification, Manual Small Incision Cataract Surgery, Visual Outcomes, Posterior Capsular Rupture.

Introduction

(PPC) is a congenital lens opacity that is distinguished by a disk-shaped, central, clearly defined opacity in the posterior capsule. It is linked to a thin and brittle posterior capsule, which raises the possibility of vitreous loss and posterior capsular rupture (PCR) after cataract surgery [1]. PPC is bilateral in 65–80% of cases and has an incidence of approximately 3–5 per 1000 cataract surgeries [2]. These anatomical features make surgical management particularly challenging, requiring careful planning and meticulous technique.

The surgical treatment of PPC involves the use of MSICS and phacoemulsification. By emulsifying the cataractous lens using ultrasonic energy,

phacoemulsification enables removal via a tiny corneal incision. In contrast, MSICS involves a larger scleral tunnel incision with manual extraction of the lens nucleus and intraocular lens implantation, often preferred in resource-limited settings [3]. Both techniques aim to optimize visual outcomes while minimizing intraoperative and postoperative complications.

Several recent studies have evaluated and compared the outcomes of phacoemulsification and MSICS in PPC cases. Dhanaseelan et al. (2023) conducted a retrospective analysis and found that both surgical approaches provided good visual outcomes, although the rate of intraoperative complications varied depending on surgeon experience [4]. Similarly, Lohiya et al. (2020) reported that posterior capsular rupture was more common in PPC cases, but favorable visual outcomes were achieved when appropriate precautions were taken intraoperatively [5].

A study by Madhumallika et al. (2025) involving 100 patients found that phacoemulsification led to faster visual recovery compared to MSICS, consistent with other reports from India and Japan indicating reduced intraoperative trauma and lower complication rates with phacoemulsification [6]. However, these studies also emphasized that visual improvement may depend on factors beyond surgical technique, including patient-specific characteristics, cataract density, and postoperative care [7].

Despite advances in surgical techniques, PPC remains a challenging cataract type due to its anatomical and physiological features. Careful preoperative evaluation, appropriate surgical planning, and adherence to meticulous intraoperative techniques are critical to minimize complications and achieve optimal outcomes [8]. Understanding the comparative efficacy of phacoemulsification and MSICS in PPC is essential for guiding surgical decisions, especially in diverse clinical settings [9].

This study aims to compare the outcomes of phacoemulsification and MSICS in patients with posterior polar cataract, focusing on visual acuity, intraoperative complications, and postoperative recovery, to provide evidence for selecting the most effective surgical approach [10].

Methodology

Study Design: This study was designed as a retrospective observational study.

Study Setting: The study was conducted at the Department of Ophthalmology, Hitech Medical College and Hospital, Rourkela: The hospital is a tertiary care center equipped with modern ophthalmic surgical facilities, including phacoemulsification machines and resources for MSICS, ensuring standardization of surgical procedures and postoperative care.

Participants: A total of 100 patients diagnosed with posterior polar cataract and who underwent cataract surgery between [January 2022 to December 2024] were included in the study. The participants were divided into two groups based on the type of surgery performed: phacoemulsification and MSICS. Demographic details, preoperative visual acuity, cataract grading, and systemic comorbidities were recorded from patient charts.

Inclusion Criteria

Patients were included in the study if they met the following criteria:

- Diagnosed with PPC confirmed on slit-lamp examination.
- Age ≥ 18 years.
- Patients who underwent either phacoemulsification or MSICS.
- Complete medical records and follow-up data available for at least 3 months postoperatively.

Exclusion Criteria

Patients were excluded if they had:

- Coexisting ocular pathology affecting visual outcome (e.g., advanced glaucoma, macular degeneration, corneal opacity).
- Previous ocular surgery in the study eye.
- Intraoperative complications unrelated to the surgical technique that could confound outcome assessment.
- Incomplete medical records or lost to follow-up.

Bias: To minimize selection bias, all consecutive eligible patients operated on during the study period were included. Observer bias in outcome assessment was reduced by using standardized criteria for postoperative visual acuity and complications. Retrospective design may limit control over some confounding variables; however, the use of strict inclusion and exclusion criteria helped mitigate this risk.

Data Collection: Information was gathered from surgical logs and hospital medical records. Preoperative visual acuity, intraoperative complications, surgical technique, duration, postoperative visual acuity at one week, one month, and three months, and any complications following surgery were among the parameters. Data collection was performed by two independent researchers to ensure accuracy and consistency.

Procedure

Surgical procedures were performed by experienced ophthalmic surgeons. In the phacoemulsification group, standard clear corneal incision and

phacoemulsification techniques were followed with foldable intraocular lens implantation. In the MSICS group, scleral tunnel incision with manual nucleus extraction and intraocular lens implantation was performed. Standard postoperative care, including topical antibiotics and corticosteroids, was prescribed for both groups. Any intraoperative or postoperative complications were noted.

Statistical Analysis: SPSS version 23.0 was used to enter and analyze the data. While categorical variables like sex and complication rates were represented as frequencies and percentages, continuous variables like age and visual acuity were represented as mean ± standard deviation. Continuous variables between the two groups were compared using independent t-tests, while categorical variables were compared using the chi-square or Fisher's exact test. P-values less than 0.05 were regarded as statistically significant.

Results

The trial involved 100 patients in total, 50 of whom were in the MSICS group and 50 of whom were in the phacoemulsification group. Participants ranged in age from 45 to 78 years old, with a mean age of 62.4 ± 8.5 years. There were 44 women (44%), and 56 men (56%). The distribution of sexes and age did not differ significantly between the two groups ($p > 0.05$).

Table 1: Demographic Characteristics of Study Participants

Parameter	Phacoemulsification (n=50)	MSICS (n=50)	p-value
Age (years, mean ± SD)	61.8 ± 8.1	63.0 ± 8.9	0.45
Male, n (%)	28 (56%)	28 (56%)	1.00
Female, n (%)	22 (44%)	22 (44%)	1.00

Both groups were comparable in terms of age and sex, suggesting no demographic bias in surgical allocation.

Preoperative Visual Acuity: Preoperative (BCVA) was similar between groups. The mean preoperative BCVA in the phacoemulsification group was 0.84 ± 0.12 LogMAR, whereas in the MSICS group it was 0.86 ± 0.11 LogMAR ($p = 0.32$), indicating comparable baseline visual function.

Intraoperative Complications: Although not statistically significant, the MSICS group experienced somewhat more intraoperative problems. Two patients (4%) in the phacoemulsification group and four patients (8%) in the MSICS group experienced posterior capsular rupture ($p = 0.40$). Three patients (6%) in the MSICS group and one patient (2%) in the phaco group experienced vitreous loss ($p = 0.31$).

Table 2: Intraoperative Complications

Complication	Phacoemulsification (n=50)	MSICS (n=50)	p-value
Posterior capsular rupture	2 (4%)	4 (8%)	0.40
Vitreous loss	1 (2%)	3 (6%)	0.31
Zonular dialysis	0 (0%)	1 (2%)	0.31

Both surgical techniques were generally safe, with phacoemulsification showing a trend toward fewer intraoperative complications.

Postoperative Visual Outcomes: Postoperative BCVA was significantly better in the phacoemulsification group at all follow-up points. At 1 month, mean BCVA was 0.18 ± 0.07 LogMAR in the phaco group and 0.28 ± 0.09 LogMAR in the MSICS group ($p < 0.001$). At 3 months, BCVA improved further to 0.12 ± 0.05 LogMAR (phaco) versus 0.22 ± 0.07 LogMAR (MSICS), demonstrating faster visual recovery with phacoemulsification.

Table 3: Postoperative Visual Acuity (LogMAR)

Follow-up	Phacoemulsification (mean ± SD)	MSICS (mean ± SD)	p-value
1 week	0.36 ± 0.10	0.48 ± 0.12	<0.001
1 month	0.18 ± 0.07	0.28 ± 0.09	<0.001
3 months	0.12 ± 0.05	0.22 ± 0.07	<0.001

Phacoemulsification provided faster and better visual rehabilitation compared to MSICS, and the difference was statistically significant at all time points.

Postoperative Complications: Early postoperative complications, such as corneal edema, were observed in 6 patients (12%) in the phaco group and 10 patients (20%) in the MSICS group ($p = 0.24$). PCO (posterior capsular opacification) at 3 months

was rare and comparable between groups. No cases of endophthalmitis were reported.

Table 4: Postoperative Complications

Complication	Phacoemulsification (n=50)	MSICS (n=50)	p-value
Corneal edema	6 (12%)	10 (20%)	0.24
Increased IOP	3 (6%)	5 (10%)	0.46
PCO at 3 months	1 (2%)	2 (4%)	0.56

Both groups demonstrated a low rate of postoperative complications, supporting the safety of both procedures.

Summary of Findings

- Both phacoemulsification and MSICS were safe and effective for posterior polar cataract.
- **Phacoemulsification** offered faster visual recovery and slightly fewer intraoperative complications.
- There was no discernible variation in the frequencies of postoperative complications or demographic variables.

Discussion

In this retrospective study of 100 patients with posterior polar cataract, both phacoemulsification and (MSICS) were found to be safe and effective surgical techniques. Age and the distribution of sexes were among the demographic traits that were similar between the two groups, indicating that patient selection did not bias the outcomes. Baseline visual acuity was similar, ensuring a fair comparison of postoperative results.

Although the differences were not statistically significant, the MSICS group experienced slightly higher intraoperative problems, including as posterior capsular rupture and vitreous loss. This finding suggests that while both procedures are generally safe, phacoemulsification may offer a technical advantage in minimizing intraoperative risk in posterior polar cataracts, likely due to its controlled nucleus removal and smaller incision size.

Postoperative visual outcomes demonstrated a clear advantage for phacoemulsification, with patients achieving better (BCVA) at 1 week, 1 month, and 3 months postoperatively compared to the MSICS group. This indicates that phacoemulsification provides faster visual rehabilitation, which can be particularly important for patients requiring rapid return to daily activities.

There were no significant adverse events like endophthalmitis recorded, and postoperative sequelae such corneal edema and elevated intraocular pressure were minimal and similar in both groups. This highlights the overall safety of both surgical techniques when performed by experienced surgeons.

Phacoemulsification (PE) and (MSICS) have both been widely studied for the management of (PPC). Evidence indicates that both techniques provide satisfactory postoperative outcomes, though posterior capsule rupture (PCR) remains a significant intraoperative concern. In a comparative study, Sinha et al. reported that although PE offered advantages in precision, PCR continued to pose a higher risk, particularly during nucleus emulsification [11]. Similarly, Choudhary et al. found no significant difference in final visual recovery between PE and MSICS, though PE cases demonstrated a slightly greater incidence of PCR [12].

Kumar et al. evaluated the visual outcomes following both procedures and observed no significant differences in postoperative recovery, reinforcing the idea that both techniques are effective for PPC management [13]. Rathi et al. further highlighted that both PE and MSICS could be safely performed, though PE surgeries demonstrated a relatively higher frequency of posterior capsule complications compared with MSICS [14].

Sastry et al. noted that PE provided better intraoperative visualization and control; however, MSICS remained a safe and effective alternative, particularly in settings with limited surgical resources [15]. Gupta et al. reinforced these findings, demonstrating that overall outcomes and complication rates were comparable between both approaches, concluding that the surgeon's skill and experience often outweigh the surgical method chosen [16]. In summary**,** the collective evidence supports that both PE and MSICS are viable, safe, and effective surgical techniques for PPC, with comparable visual outcomes, though PE may carry a marginally higher risk of PCR.

Conclusion

Both phacoemulsification and MSICS are safe and effective for managing posterior polar cataracts. Phacoemulsification provides faster visual recovery and a slightly lower risk of intraoperative complications, making it the preferred choice when resources and expertise are available. MSICS remains a reliable alternative in resource-limited settings.

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